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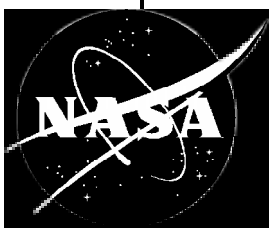
## MISSION OPERATIONS AND DATA SYSTEMS DIRECTORATE

# Interface Control Document (ICD) Between the Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) and Spacecraft Analysis System (SAS)

**September 1997**




National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

# Interface Control Document (ICD) Between the Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) and Spacecraft Analysis System (SAS)

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# Preface

This document is under the configuration management of the National Aeronautics and Space Administration (NASA) Communications (Nascom) Division Configuration Control Board (CCB).

Proposed changes to this document shall be submitted to the Nascom CCB, along with supportive material justifying the change. Changes to this document shall be made by Document Change Notice (DCN) or by complete revision.

Questions concerning this document and proposed changes shall be addressed to:

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# Abstract

This Interface Control Document (ICD) describes interface agreements between the Spacecraft Analysis System (SAS) and Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet).

***Keywords:*** *EBnet, ICD, Interface Control Document, SAS, Spacecraft Analysis System*

# Change Information Page

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## Abbreviations and Acronyms

# Section 1. Introduction

## 1.1 Authority and Responsibility

The Mission Operations and Data Systems Directorate (MO&DSD) has the authority to implement the Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet). This authority was granted to MO&DSD by the EOS project under the Office of Mission to Planet Earth (Code Y). The EBnet project is under the National Aeronautics and Space Administration (NASA) Communications (Nascom) Division of the MO&DSD.

Code 540 will provide an operational communications network to support high-speed network communications between EBnet and non-EBnet hosts. The primary responsibility for this project has been assigned to the Nascom Division, Code 540. The system requirements are documented by the references in Section 2.1.

## 1.2 Purpose

The purpose of the interface between the SAS and EBnet is to support connectivity between the SAS and the EOS Operations Center (EOC), between the SAS and the Ground Support Equipment (GSE), and between the SAS and the Software Development Facility (SDF). All data flows into or out of the SAS supported by EBnet are considered to be science traffic [for purposes of EBnet Interface Control Documents (ICDs), any traffic type which is not real time is considered to be science traffic].

## 1.3 Scope

This ICD defines and controls the functions, communications protocol(s), frame formats, and electrical characteristics of the interfaces between EBnet-provided equipment, software, and communications paths and other entities that directly interface with the network. Interfaces provided by Nascom are included in the scope of this document. Interfaces between EBnet users and other systems not provided by Nascom are not within the scope of this document.

## 1.4 Time Frame

This ICD shall be in effect from the date of the last approval signature.

## 1.5 Goals and Objectives

The goals of EBnet are to:

a. Implement an operational, integrated, transparent communications system that serves the data communications needs of projects supported by NASA Goddard Space Flight Center (GSFC), and users outside the MO&DSD.

b. Expand using industry standard system solutions while maintaining compatibility with the existing network and user interfaces.

c. Minimize costs for implementation, operation, and maintenance of the network.

d. Minimize life-cycle costs.

e. Maintain high availability by designing with redundancy, and without single points of failure in the Network Backbone, where required.

f. Utilize state-of-the-art technology, utilizing equipment with the best price-performance available commercially.

g. Allow for growth, adaptability to changing requirements, infusion of new technology, and upgraded interfaces throughout the life-cycle.

## 1.6 Standards Precedence

EBnet will be based on Government, commercial, and international standards. In case of conflict, the following precedence (in descending order) applies:

- This EBnet ICD.
- Government standards.
- Commercial and/or international standards.

## 1.7 Document Organization

Section 2 contains parent, applicable, and reference documents related to this ICD.

Section 3 details a systems overview of the EBnet, SAS, and the interrelationship.

Section 4 describes the EBnet system architecture and identifies the standards supported at each level of the International Organization for Standardization (ISO) model.

Section 5 describes the facilities and maintenance demarcation.

A list of abbreviations and acronyms is provided at the end of the document.

# Section 2. Related Documentation

## 2.1 Parent Documents

[1] *Earth Observing System AM-1 Detailed Mission Requirements*, Goddard Space Flight Center (GSFC), 505-10-33, November 1996

[2] *Earth Science Data Information System (ESDIS) Project Level 2 Requirements Volume 6, EOSDIS Backbone Network (EBnet) Requirements*, Goddard Space Flight Center (GSFC) 505-10-01-6, Revision A, December 1996

[3] *Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) Interface Requirements Document (IRD)*, September 1997

[4] Reserved

## 2.2 Applicable Documents

[5] *Electrical Characteristics of Balanced Voltage Digital Interface Circuits*, Electronic Industries Association (EIA) 422-A, December 1978

[6] *General-Purpose 37-Position and 9-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*, EIA 449, November 1977

[7] *Internet Protocol (IP): DARPA Internet Program Protocol Specification*, Request for Comment (RFC) 791, September 1981

[8] *The Point-to-Point Protocol (PPP)*, RFC 1661, July 1995

[9] *An Ethernet Address Resolution Protocol or Converting Network Protocol Addresses to 48-bit Ethernet Addresses for Transmission on Ethernet Hardware*, RFC 826, November 1982

[10] *Internet Control Message Protocol*, RFC 792, September 1981

[11] *Routing Information Protocol (RIP)*, RFC 1058

[12] *Open Shortest Path First (OSPF)*, RFC 1247

[13] *Internet Group Multicast Protocol (IGMP)*, RFC 1112

[14] *On the Assignment of Subnet Numbers*, RFC 1219

[15] *Simple Network Management Protocol (SNMP)*, RFC 1157

[16] (reserved)

[17] *A Reverse Address Resolution Protocol (RARP)*, RFC 903

[18] *Internet Protocol on Ethernet Networks*, RFC 894

[19] *Transmission of IP over FDDI*, RFC 1188

[20] *Structure of Management Information*, RFC 1155

[21] *Management Information Base - II*, RFC 1213

[22] *Transmission Control Protocol*, RFC 793

[23] *Telnet Protocol*, RFCs 854 & 855

[24] *File Transfer Protocol*, RFC 959

[25] ISO 9314-1, *FDDI Physical Layer Protocol (PHY)*

[26] ISO 9314-2, *FDDI Media Access Control (MAC) Protocol*

[27] ISO 9314-3, *FDDI Physical Layer Medium Dependent (PMD)*

[28] ISO 8802-2, *Logical Link Control (LLC)*

[29] ISO 8802-3, *Carrier-Sense Multiple-Access with Collision Detection (CSMA/CD) Media Access Control (MAC) - Ethernet version 2*

[30] Institute of Electrical and Electronic Engineers (IEEE) 802.3 *10Base-T (twisted pair)*

[31] IEEE *10Base5 (thick ethernet)*

[32] International Telegraph and Telephone Consultative Committee (CCITT) *V.35*

## 2.3 Reference Documents

[33] *NASA Communications (Nascom) Access Protection Policy and Guidelines*, 541-107, Revision 3, GSFC, November 1995

[34] *NASA Communications System Acquisition and Management*, NASA Management Instruction (NMI) 2520.1D, National Aeronautics and Space Administration (NASA), November 18, 1991

[35] *Nascom IONET Users Guide*, 541-225, Revision 1, April 1996

[36] *Interface Control Document Between EOSDIS Core System (ECS) and the EOS-AM Project for AM-1 Spacecraft Analysis System*, 209-CD-003-002, Hughes Information Technology Corporation, October 1995

[37] *Interface Requirements Document between the Earth Observing System Data and Information System (EOSDIS) and the AM Project for AM-1 Flight Operations*, 505-41-15, GSFC, July 1995

# Section 3. Systems Overview

## 3.1 EBnet General System Description

The EBnet provides wide-area communications circuits and facilities between and among various EOS Ground System (EGS) elements to support mission operations and to transport mission data between EOSDIS elements. The relationship of EBnet to other elements supporting EOS is shown in Figure 3-1. EBnet is responsible for transporting spacecraft command, control, and science data nationwide on a continuous basis, 24 hours a day, 7 days a week. The EBnet capability to transport these diverse types of data is implemented as two distinct subnetworks referred to as "real-time" and "science" networks. The real-time network transports mission-critical data related to the health and safety of on-orbit space systems and raw science telemetry as well as pre-launch testing and launch support. This highly redundant network provides an operational availability of 0.9998 with a Mean Time to Restore Service (MTTRS) of 1 minute. The science network transports data collected from spacecraft instruments and various levels of processed science data including expedited data sets, production data sets, and rate-buffered science data. The science network provides an operational availability of 0.98 with a MTTRS of 4 hours.

EBnet provides three options for accessing the Internet Protocol (IP)-based EBnet transport service: Local Area Network (LAN) Ethernet, LAN Fiber Distributed Data Interface (FDDI), and Wide Area Network (WAN) carrier service. Figure 3-2 shows an example of each of these types of interface/demarcation points to EBnet users. This ICD describes the EBnet/SAS interface which uses the LAN interface type.

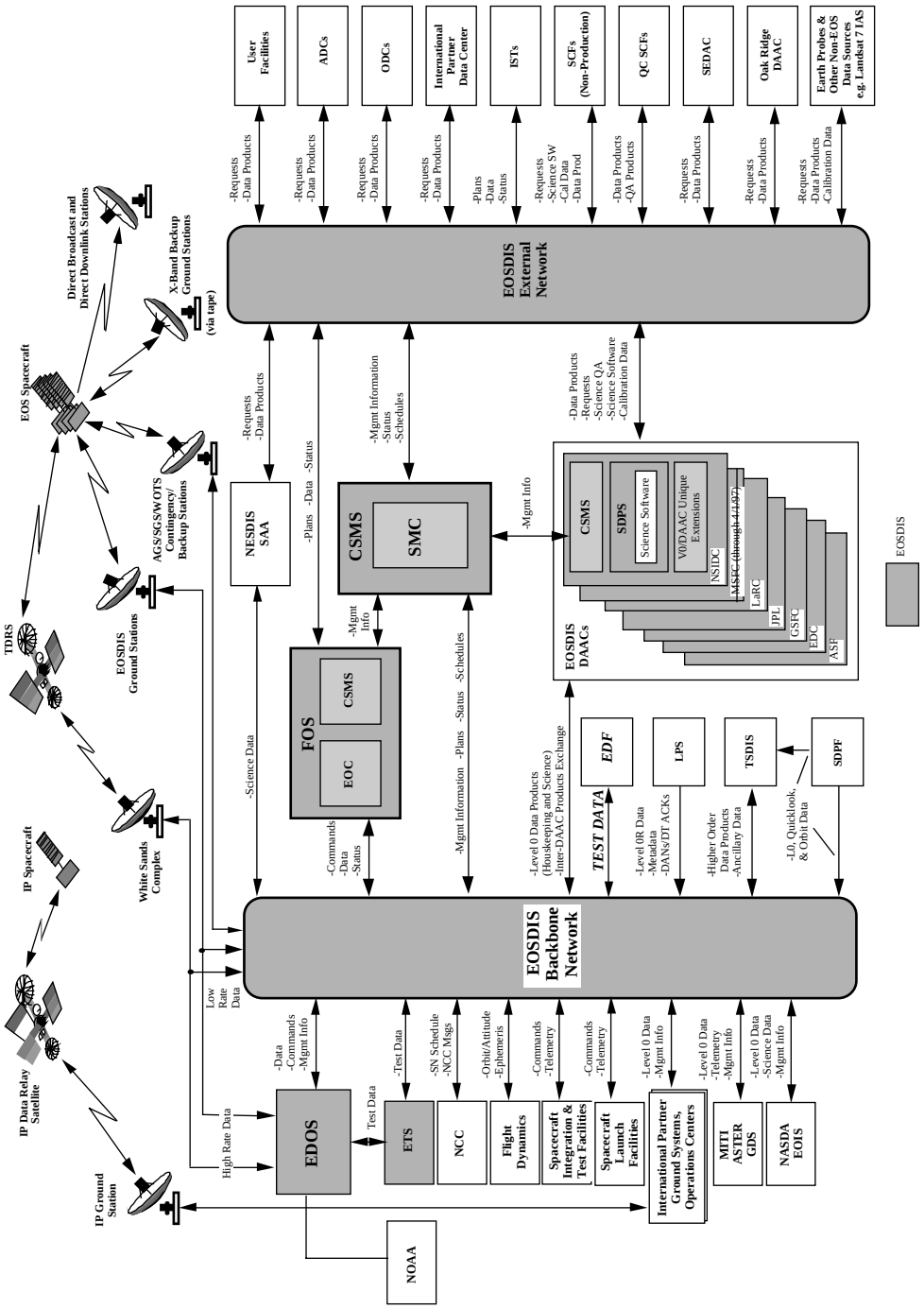


***Figure 3-1. EOS Ground System***

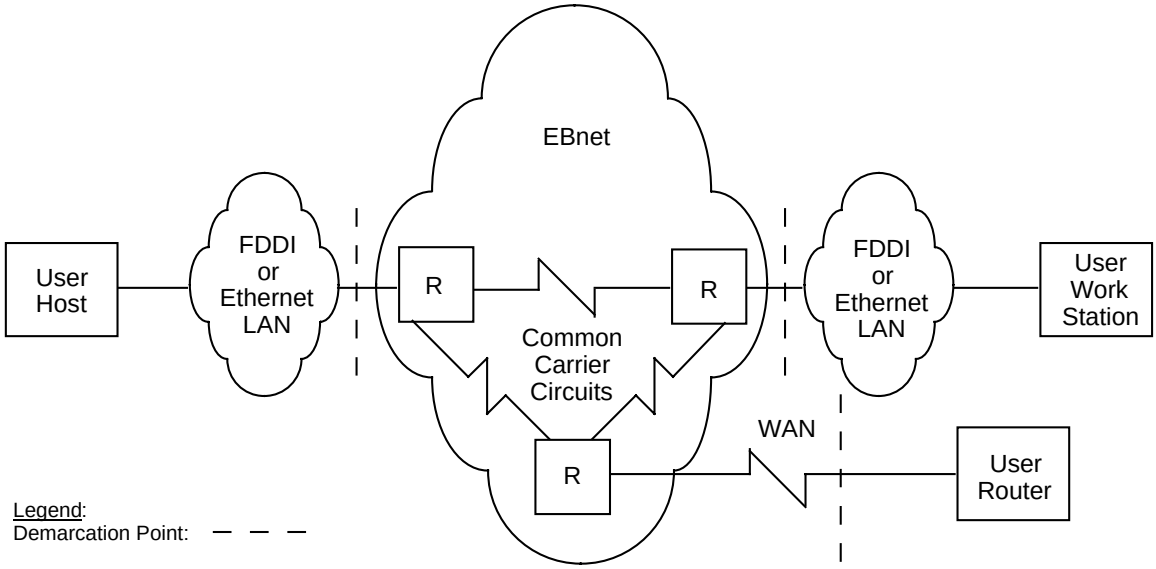


***Figure 3-2. EBnet Demarcations***

Sustaining engineering, preventive and remedial maintenance, and network monitoring services are provided for EBnet equipment, to ensure that EBnet keeps pace with technology and standards, and provides continuous service. The official point of contact for EBnet operational status is the Nascom Communications Manager (COMMGR) (301-286-6141). Users who detect a network problem are urged to immediately report it to the COMMGR. The COMMGR may also provide users with limited information about maintenance and status actions. Refer to the Nascom IP Operational Network (IONET) User Guide (541-225) for information regarding user connections, security guidelines, and maintenance information.

## 3.2 SAS Description

The SAS is a software toolset developed by the AM-1 spacecraft vendor to provide flight performance and evaluation functions for the AM-1 spacecraft. This toolset is used during spacecraft Integration and Test (I&T) and early orbit operations to analyze spacecraft performance trends, detect failures, and evaluate subsystem performance. The SAS may also be used by the Flight Operations Team (FOT) throughout the mission, on an infrequent basis, to support specialized mission analyses at the EOC which are not supported by the Flight Operations Segment (FOS) Analysis Subsystem. The SAS will be installed in the EOC at Building 32 at GSFC, as a vendor-integrated/provided workstation—the SAS Workstation. The SAS Workstation requires IP support for it to communicate with the GSE and the EOC. Functionally, the EOSDIS Core System (ECS)/AM-1 SAS interface is depicted in Figure 3-3.

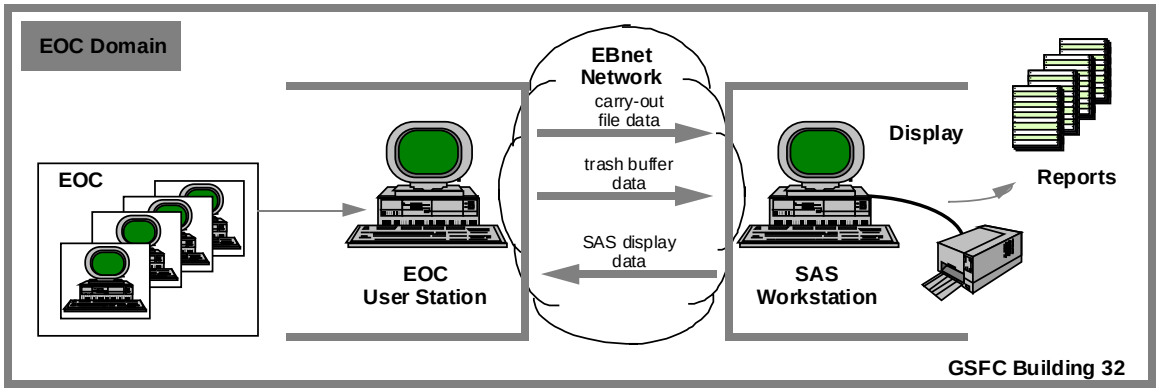


***Figure 3-3. ECS/AM-1 SAS Interface***

## 3.3 Relationship Between EBnet and SAS

The EOC User Stations and the SAS Workstation, as shown in Figure 3-3, are collocated within the EOC and may even reside in close proximity. The EOC User Stations are connected to the EOC LAN which in turn interfaces with EBnet. The SAS Workstation also connects to the EBnet, thereby providing the physical network link between the EOC and the SAS Workstation. Figure 3-4 depicts a high-level view of segments of the GSFC EBnet node providing the physical link between the EOC and the SAS Workstation.

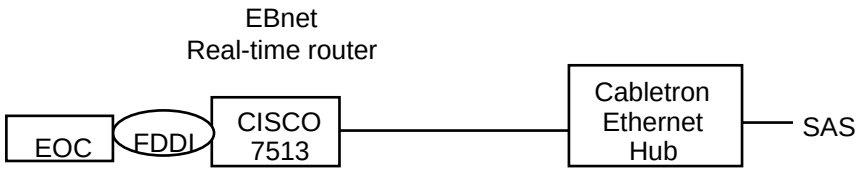


***Figure 3-4. EBnet Exchange LAN Interface for the SAS Workstation***

# Section 4. Interface Detailed Design

## 4.1 Interface Design Overview

The EBnet/SAS interface design is based on the requirement to provide a communication path between the SAS Workstation and EOC User Stations. The SAS Workstation interfaces with the GSFC EBnet node via Ethernet to a Bay Networks router (refer to Figure 3-4).

## 4.2 Design Assumptions

a. The only type of interface required for the SAS Workstation is Ethernet.

b. The data rate into and out of the SAS Workstation will be approximately 56 kilobits per second (kbps).

c. The SAS Workstation will be installed in the EOC, Building 32, GSFC. At no time prior to its installation in the EOC will EBnet communication be required for it, for example, there is no requirement to provide an interface between the EOC and the SAS Workstation while that workstation is at the spacecraft vendor's facility in Valley Forge.

## 4.3 Data Interface Design

The following information is known about the design of the data interface for the SAS Workstation at GSFC. Routers and a FDDI switch provide the data communication interface for the Ethernet link to the SAS Workstation. The protocols for each layer are described in the following paragraphs.

### 4.3.1 ISO Layer One Interface Control (Physical Layer)

EBnet will support the following physical layer connections:

a. IEEE 802.3 10BaseT (unshielded twisted pair) with RJ45 connectors.

b. IEEE 10Base5 (thick Ethernet, RG-8 coax, 50 ohm impedance) with 15-pin connector.

### 4.3.2 ISO Layer Two Interface Control (Data Link Layer)

EBnet will support the following data link layer protocols:

a. ISO 802.2 Logical Link Control (LLC).

b. ISO 8802-3 Carrier-Sense Multiple-Access with Collision Detection (CSMA/CD) Media Access Control (MAC) - Ethernet Version 2.0 is supported.

### 4.3.3 ISO Layer Three Interface Control (Network Layer)

EBnet will support the following network layer protocols:

a. Request for Comment (RFC) 791, Internet Protocol Version 4.0.

b. RFC 1157, Simple Network Management Protocol (SNMP).

c. RFC 826, Address Resolution Protocol (ARP).

d. RFC 903, A Reverse Address Resolution Protocol (RARP).

e. RFC 1058, Routing Information Protocol (RIP).

f. RFC 1247, Open Shortest Path First (OSPF).

### 4.3.4 ISO Layer Four Interface Control (Transport Layer)

EBnet will support transparent communication at the transport layer.

### 4.3.5 ISO Layer Five Interface Control (Session Layer)

EBnet will support transparent communication at the session layer.

### 4.3.6 ISO Layer Six Interface Control (Presentation Layer)

EBnet will support transparent communication at the presentation layer.

### 4.3.7 ISO Layer Seven Interface Control (Application Layer)

EBnet will support transparent communication at the application layer.

### 4.3.8 Network/Station Management Protocols

EBnet shall support, at a minimum, the following management protocol:

a. SNMP.

## 4.4 Routing and Addressing Guidelines

EBnet will be internetworked by routers and switches which will be configured to support only the IP protocol, and will provide isolation for separate networks. Cisco 7513 and Bay Network BCN routers have been chosen to provide network access to users.

EBnet will utilize standard IP addressing conventions. The SAS IP address will be assigned from a range of IP addresses preassigned to the EBnet Ethernet hub located in Building 32.

## 4.5 Performance

The EBnet/SAS Workstation interface shall meet the following performance specifications:

a. Data rate: approximately 56 kbps in both directions.

b. Restoral: since this is not a real-time interface, the EBnet system design will support a MTTRS of 4 hours.

## 4.6 Data Flow Requirements

The purpose of the interface between SAS and EBnet is to support connectivity between SAS and the various internal and external systems including the GSE at Valley Forge.

## 4.7 Equipment List

EBnet will provide the following equipment to support this interface:

a. Router: Cisco (Model 7513).

b. Router: Bay Networks (Model BCN).

c. Ethernet Hub: Cabletron (Model SEHI-24).

# Section 5. Facilities and Maintenance Demarcation

## 5.1 Equipment Location

EBnet will interface to the SAS workstation located in Building 32 at GSFC. EBnet equipment will be located in Building 32, C210H.

## 5.2 Maintenance Demarcation

The demarcation point between EBnet maintenance and SAS maintenance is the connection at the EBnet Ethernet hub. The user is responsible for cables to the EBnet demarcation.

# Abbreviations and Acronyms

| | |
|---|---|
| ARP | Address Resolution Protocol |
| CCB | Configuration Control Board |
| CCITT | International Telegraph and Telephone Consultative Committee |
| COMMGR | Communications Manager |
| CSMA/CD | Carrier-Sense Multiple-Access with Collision Detection |
| DCN | Document Change Notice |
| EBnet | EOSDIS Backbone Network |
| ECS | EOSDIS Core System |
| EGS | EOS Ground System |
| EOC | EOSDIS Operations Center |
| EOS | Earth Observing System |
| EOSDIS | Earth Observing System Data and Information System |
| ESDIS | Earth Science Data and Information System |
| FDDI | Fiber Distributed Data Interface |
| FOS | Flight Operations Segment |
| FOT | Flight Operations Team |
| GSE | Ground Support Equipment |
| GSFC | Goddard Space Flight Center |
| ICD | Interface Control Document |
| IEEE | Institute of Electrical and Electronic Engineers |
| IONET | IP Operational Network |
| IP | Internet Protocol |
| ISO | International Organization for Standardization |
| LAN | Local Area Network |
| LLC | Logical Link Control |
| MAC | Media Access Control |
| MO&DSD | Mission Operations and Data Systems Directorate |

| | |
|---|---|
| MTTRS | Mean Time to Restore Service |
| NASA | National Aeronautics and Space Administration |
| Nascom | NASA Communications |
| NMI | NASA Management Instruction |
| OSPF | Open Shortest Path First |
| RARP | Reverse Address Resolution Protocol |
| RFC | Request for Comment |
| RIP | Routing Information Protocol |
| SAS | Spacecraft Analysis System |
| SNMP | Simple Network Management Protocol |
| WAN | Wide Area Network |